



## Principles of Plant Science and Hydroculture

<b>Primary Career Cluster:</b>	Agriculture, Food and Natural Resources
<b>Consultant:</b>	Steven Gass, (615) 532-2847, <a href="mailto:Steven.Gass@tn.gov">Steven.Gass@tn.gov</a>
<b>Course Code(s):</b>	6119
<b>Prerequisite(s):</b>	<i>Agriscience</i> (5957)
<b>Credit:</b>	1
<b>Grade Level:</b>	10
<b>Graduation Requirements:</b>	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Agriculture courses.
<b>Programs of Study and Sequence:</b>	This is the second course in the <i>Horticulture Science</i> program of study.
<b>Aligned Student Organization(s):</b>	FFA: <a href="http://www.tnffa.org">http://www.tnffa.org</a> Allie Ellis, (615) 253-5207, <a href="mailto:Allie.Ellis@tn.gov">Allie.Ellis@tn.gov</a>
<b>Coordinating Work-Based Learning:</b>	All Agriculture students are encouraged to participate in a Supervised Agricultural Experience (SAE) program. In addition, Teachers are encouraged to use embedded WBL activities. For information, visit <a href="http://tn.gov/education/cte/work_based_learning.shtml">http://tn.gov/education/cte/work_based_learning.shtml</a> .
<b>Available Student Industry Certifications:</b>	Worker Protection Standard (WPS) for Agricultural Pesticides
<b>Dual Credit or Dual Enrollment Opportunities:</b>	There are no statewide dual credit/dual enrollment opportunities for this course. If interested in establishing a local opportunity, reach out to a local postsecondary institution.
<b>Teacher Endorsement(s):</b>	048, 150, 448
<b>Required Teacher Certifications/Training:</b>	While not required to teach the course, teachers who use a greenhouse facility or an outdoor lab (cold frame, nursery, etc.) that uses any type of chemical (with an EPA label) must have the Commercial Pesticide Applicators License for C10 and C15.
<b>Teacher Resources:</b>	<a href="http://www.tn.gov/education/cte/AgricultureFoodNaturalResources.shtml">http://www.tn.gov/education/cte/AgricultureFoodNaturalResources.shtml</a>

### Course Description

*Principles of Plant Science and Hydroculture* focuses on essential knowledge and skills related to the science of plant growth. This course covers principles of plant health, growth, reproduction, and biotechnology, as well as fundamental principles of hydroponics and aquaponics. Upon completion of this course, proficient students will be prepared for more advanced coursework in horticulture science. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy

in Technical Subjects, Tennessee State Standards in Mathematics, Tennessee state standards for Biology I, Biology II, Ecology, and Environmental Science, and National Agriculture, Food and Natural Resources Career Cluster Content Standards.\*

## **Program of Study Application**

This is the second course in the *Horticulture Science* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Agriculture, Food, and Natural Resources website at

<http://www.tn.gov/education/cte/AgricultureFoodNaturalResources.shtml>.

## **Course Standards**

### **Safety**

- 1) Differentiate general occupational safety prevention and control standards as related to the plant science and hydroculture industry. Apply concepts of safety procedures to complete safety test with 100 percent accuracy. Obtain the worker protection standards student industry certification. (TN Reading 3)

### **Plants, Society, and the Environment**

- 2) Investigate the roles of cultivated plants in meeting the food, fiber, fuel, medicinal, aesthetic, and occupational needs of society. Identify and describe, in an informative text, the different domains of the horticulture industry, and examine current issues and trends affecting professionals in the field. Cite specific textual evidence from government publications and news media. (TN Reading 1; TN Writing 2, 7, 8)
- 3) Summarize the impact and patterns of environmental factors on plant biodiversity by examining research from academic journals, news articles, and government publications. Describe important characteristics of the relationships between plants and other organisms, including basic plant-human interactions, plant-animal interactions, and plant adaptation. (TN Reading 2; TN Writing 4; TN Biology I 2, 5; TN Biology II 2, 5; TN Ecology 6; TN Environmental Science 2)

### **Principles of Soil Science**

- 4) Evaluate, citing specific textual evidence, the physical and chemical properties of soils in an informative text. Perform technical procedures to classify soils by evaluating biotic and abiotic factors such as soil pH, texture, permeability, and water holding capacity. Interpret test results to identify deficiencies and formulate appropriate corrective actions. (TN Reading 3)
- 5) Describing factors that influence soil quality and erosion. Assess the extent to which reasoning and evidence presented in news articles or case studies support the use of a specific soil conservation practice for maintaining healthy growing media for plants. (TN Reading 8; TN Writing 2, 7)
- 6) Cite specific textual evidence for the analysis of land selection and conservation practices that ensure optimal productivity and stewardship. Identify factors that affect site selection for plant

growth and draw evidence from multiple authoritative sources to appraise and justify management practices that ensure appropriate use of land resources. (TN Reading 1, 8; TN Writing 9; TN Ecology 6; TN Environmental Science 4)

### **Plant Structure and Function**

- 7) Integrate print and digital sources to create a model depicting the parts of plant cells. Examine the structure and outline the functions of plant cell organelles. (TN Reading 2, 7; TN Biology I 1; TN Biology II 1, 7)
- 8) Analyze plant anatomy and physiology and relate key concepts to the processes and requirements involved in plant growth and productivity. (TN Biology II 6, 7)

### **Plant Nutrition**

- 9) Analyze the nutrient requirements of plants and assess the importance of essential plant nutrients to plant growth and development. Use visual representations to illustrate the chemical and biological processes, including photosynthesis, that make nutrients available to plants for growth and maintenance. (TN Writing 4, 9; TN Biology II 7)
- 10) Justify the use of fertilizers as a source of essential plant nutrients. Calculate fertilizer formulations and perform different methods of fertilizer application. (TN Reading 1, 3; TN Math N-Q)
- 11) Research the nutritional factors that influence plant health to identify nutritional deficiencies and disorders. Compile observations to distinguish between the signs of nutrient deficiency in plants and defend recommendations for appropriate treatments. (TN Biology II 7)

### **Plant Diseases and Pests**

- 12) Research the principles of disease and pest control to plant health, growth, and maintenance. Analyze the effects of different types of plant pests and diseases; prescribe methods for pest and disease prevention and treatment. (TN Reading 2)
- 13) Demonstrate understanding of common classes of chemicals used for pest management. Gather and evaluate information regarding PPE (Personal Protective Equipment) for chemical application and demonstrate appropriate use of PPE. Create a checklist for safe storage and handling of pesticides. (TN Reading 3; TN Writing 4)

### **Plant Breeding and Genetics**

- 14) Analyze the reproductive structures in plants and describe how they function in both sexual and asexual plant reproduction. (TN Biology II 7)
- 15) Investigate the role of DNA, heritability, and genetic applications in plant breeding and compose an informative essay that describes how mutation, gene flow, and adaption influence plant populations. Identify desirable traits in various plant species and predict the probable outcome

of genetic crosses based on Mendel's laws. (TN Reading 3; TN Writing 2, 7; TN Biology I 4; TN Biology II 4)

### **Plant Biotechnology**

- 16) Distinguish the branches of science that influence plant biotechnology and summarize important historical achievements. Examine the role and importance of genetic principles to improving plant characteristics and perform basic plant DNA extraction procedures. (TN Reading 2, 3; TN Writing 4; TN Biology I 4; TN Biology II 4)
- 17) Research current and emerging plant biotechnologies and construct an argumentative essay to support a claim supporting or opposing the use of a specific biotechnology in horticulture. Justify and debate ethical, legal, and economic issues surrounding plant biotechnology. (TN Reading 2, 8; TN Writing 1, 7)

### **Fundamentals of Hydroponics and Aquaponics**

- 18) Evaluate the significance of hydroponics and aquaponics technology as related to sustainable practices and principles. Compare and contrast production systems and techniques utilized in the hydroponics and aquaponics fields, including structures and equipment, production methods, and common crops. (TN Ecology 6; TN Environmental Science 7)
- 19) Assess the functions, attributes, and desirable properties of soilless growing media. Write an informative essay to describe the major components of soilless media, identifying basic physical and chemical characteristics. (TN Reading 9; TN Writing 2)
- 20) Apply concepts learned in this course to visually identify common plant and animal species used for hydroponic and aquaponic production, and distinguish between their structural and physiological differences, as well as their specific production applications. (TN Reading 3; TN Biology II 6)
- 21) Examine the role that water chemistry plays in the development of water quality for plant production. Demonstrate the ability to perform common tests to evaluate water quality factors including pH, hardness, ammonium, nitrate, nitrite, dissolved oxygen, and ammonia levels. (TN Reading 3; TN Math N-Q)
- 22) Analyze the effects of environmental conditions on aquatic plant and animal life. Adjust water quality factors by using quantitative reasoning and appropriate units to calculate proper formulations of chemicals based upon label directions. (TN Reading 3; TN Math N-Q; TN Biology I 2, TN Biology II 2)

## Standards Alignment Notes

\*References to other standards include:

- TN Reading: [Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects](#); Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 4, 5, 6, and 10 at the conclusion of the course.
- TN Writing: [Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects](#); Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 5, 6, and 10 at the conclusion of the course.
- TN Math: [Tennessee State Standards for Mathematics](#); Math Standards for High School: Number and Quantity.
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project-based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- SAE: [Supervised Agricultural Experience](#): All Agriculture students are encouraged to participate in a Supervised Agricultural Experience program to practice and demonstrate the knowledge and skills learned in their agriculture courses.
- TN Biology I: Tennessee Science: [Biology I](#), standards 1, 2, 3, 4.
- TN Biology II: Tennessee Science: [Biology II](#), standards 1, 2, 4, 5, 6, 7.
- TN Ecology: Tennessee Science: [Ecology](#), standard 6.
- TN Environmental Science: Tennessee Science: [Environmental Science](#), standards 2, 4, 7.
- AFNR: [National Agriculture, Food and Natural Resources \(AFNR\) Career Cluster Content Standards](#): Students engaged in activities outlined above should be able to demonstrate fluency in Standards BS and PS at the conclusion of the course.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.